Nov. 8, 1927.

1,648,141

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INTERNAL COMBUSTION ENGINE

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FIGURE #1

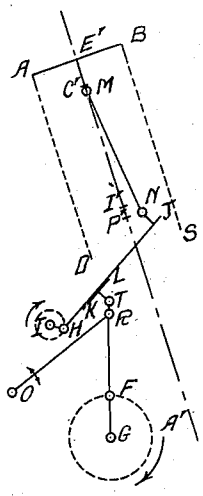


FIGURE #2

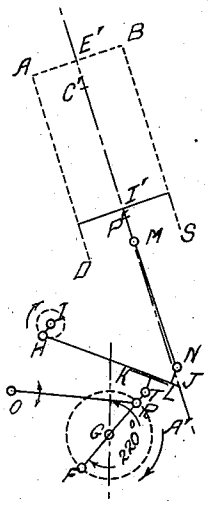
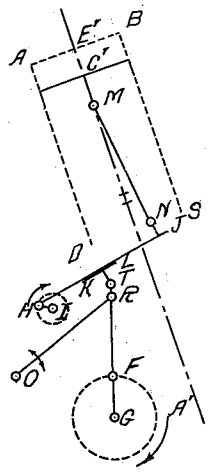


FIGURE #3



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FIGURE #3A

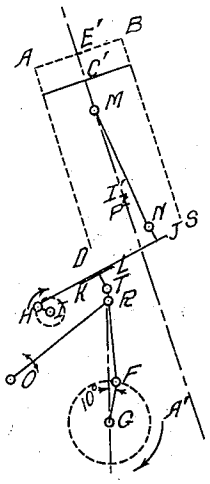


FIGURE #4

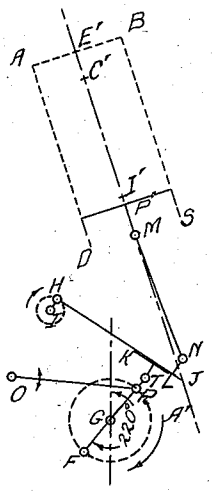
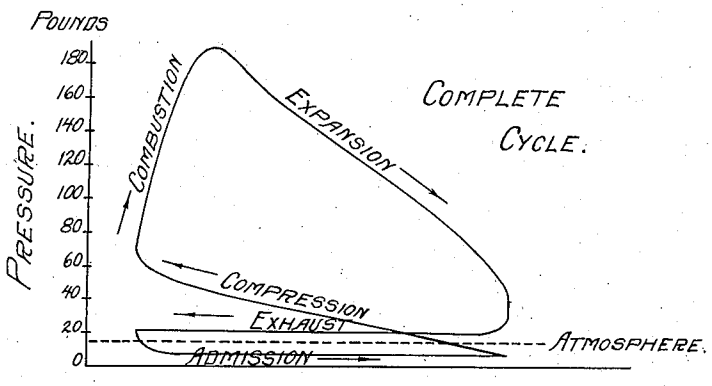


FIGURE #5



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Fig. 6

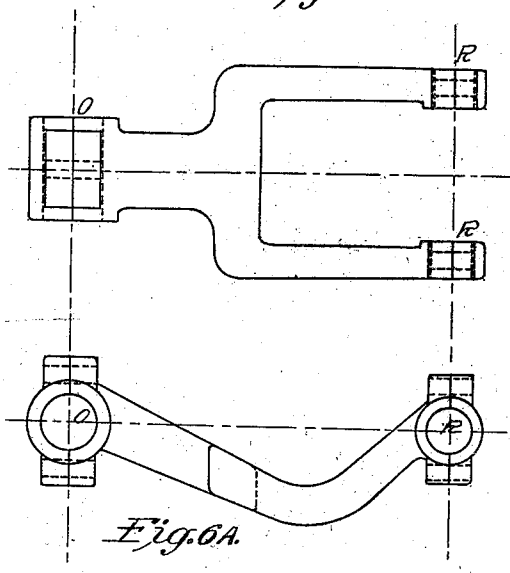


Fig. 6A.

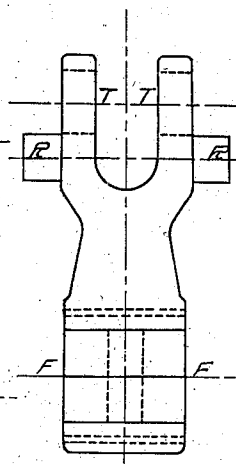


Fig. 7

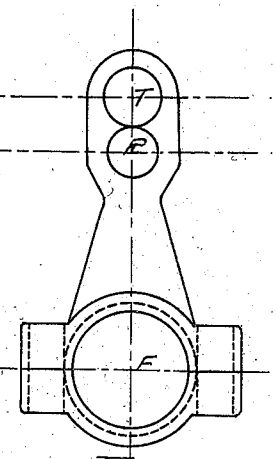


Fig. 7A.

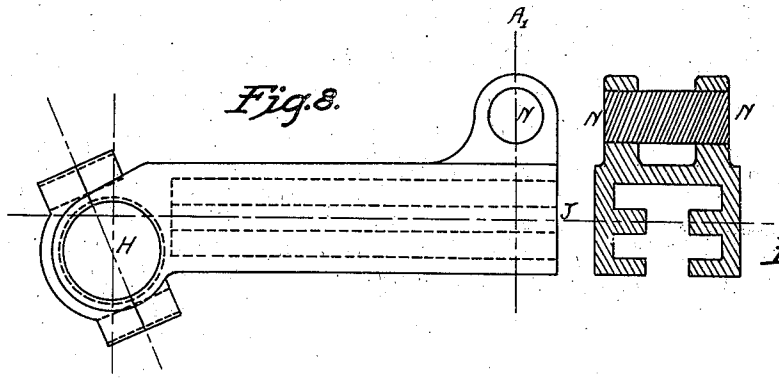


Fig. 8.

Fig. 8B.

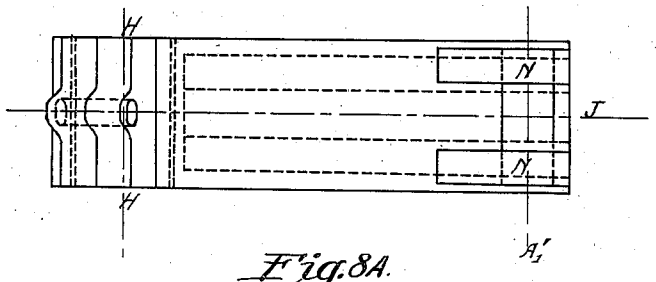


Fig. 8A.

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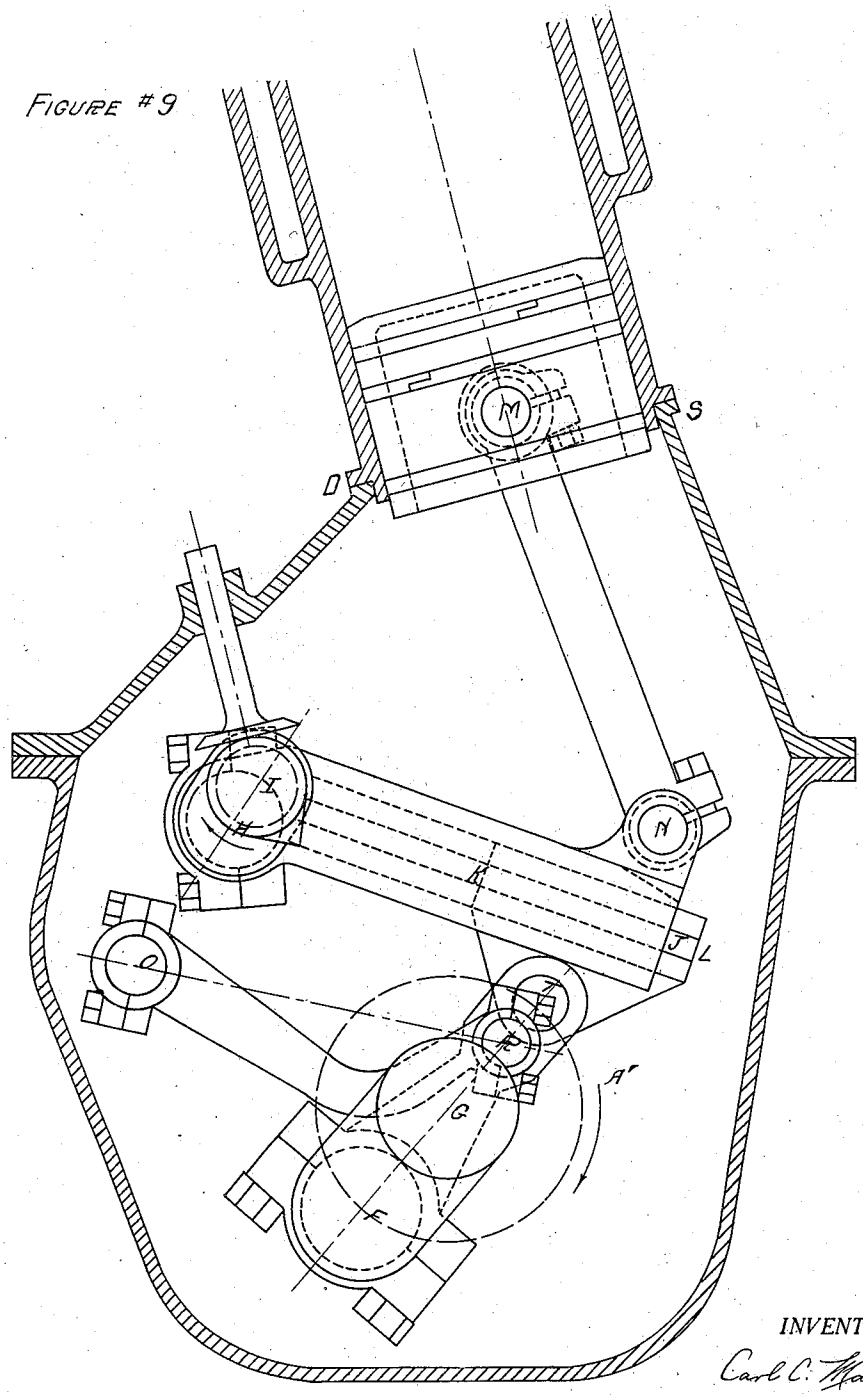
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FIGURE #9



INVENTOR.

Carl C. Martin

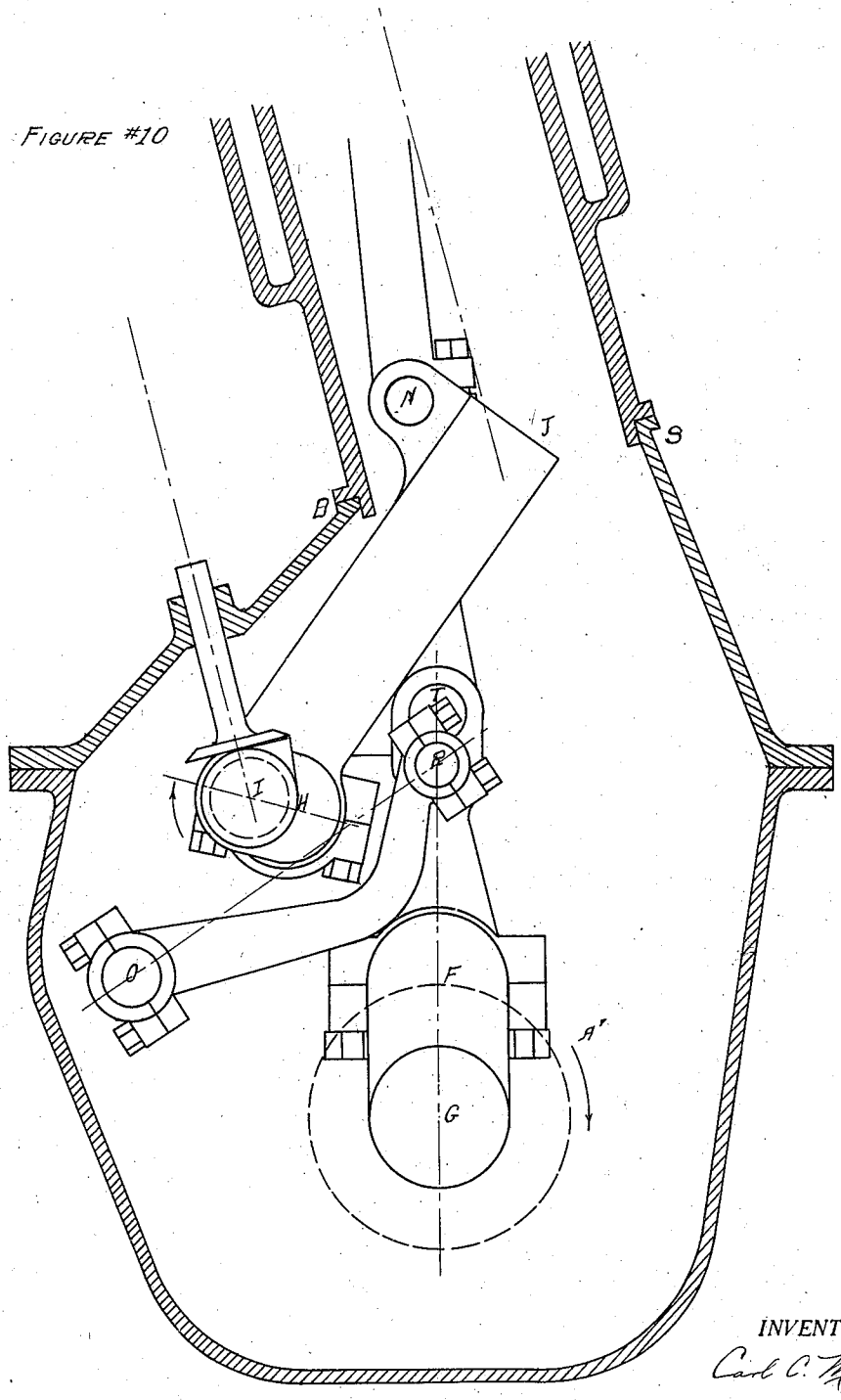
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FIGURE #10



INVENTOR.

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Patented Nov. 8, 1927. 1,648,141

UNITED STATES PATENT OFFICE.

CARL C. MARTIN, OF NEIHART, MONTANA.

INTERNAL-COMBUSTION ENGINE.

Application filed February 20, 1925. Serial No. 10,574.

The invention relates to improvements in internal combustion engines which have a four stroke cycle of operation; and the object of the improvement is to obtain a greater efficiency from the fuel consumed than is obtained by the conventional type of engine. The mechanism necessary to acquire the advantages of this leverage cycle consists of three mechanical units working so as to control the position and speed of the piston, as well as the turning force on the crank, during the cycle of operation of the engine. The first unit (described in detail under Part A) is a lever arrangement whereby the speed of the piston and the torque or turning force on the crank are made to vary with the pressure of the exploding gas in the cylinder. Since, from the pressure curve for internal combustion engines shown in Figure #5, the pressure is extremely great at the beginning of the power stroke and gradually decreases to the end of this stroke, it is possible, by this arrangement, to distribute the torque or turning force on the crank more evenly over a larger arc of the crank circle than it is in the ordinary engine. The second unit (described in detail under Part B) is for a scavenger purpose and is to completely exhaust the cylinder after the power stroke. Since nearly one-fifth of the volume of a cylinder, in an engine operating at 65 pounds gauge compression at sea level, is used for the compression cavity, practically twenty percent of the explosive mixture consists of burned gases not excluded during the previous cycle of operation. By this mechanical arrangement nearly all the products of combustion are exhausted from the cylinder after each explosion, and the efficiency of the explosive mixture is greatly increased. The third unit (described in detail under Part C) is for the purpose of holding the piston at its highest position on compression until the crank has passed through dead center and, in this way, eliminating the waste of energy resulting from the tendency, in the common engine, for the piston to drive directly through the center of the crank circle during the beginning of the power stroke.

Figure 1 is a diagrammatic illustration of the engine at the beginning of the intake stroke,

Figure 2 is a diagrammatic illustration of the engine at the beginning of the compression stroke,

Figure 3 is a diagrammatic illustration of the engine at the beginning of the power stroke,

Figure 3^A is a diagrammatic illustration of the engine at the beginning of the power stroke just beyond dead center,

Figure 4 is a diagrammatic illustration of the engine at the beginning of the exhaust stroke,

Figure 5 is a graph of the pressure curve for the common 4-cycle engine,

Figure 6 is a plan view of the adjustable arm,

Figure 6^A is a side view of the adjustable arm,

Figure 7 is a plan view of the secondary connecting rod,

Figure 7^A is a side view of the secondary connecting rod,

Figure 8 is a side view of the race-way arm,

Figure 8^A is a plan view of the race-way arm,

Figure 8^B is a section along the line A′—A′ of Figure 8,

Figure 9 is a sectional view of my improved engine, and

Figure 10 is another sectional view of my improved engine.

The Figures #1, 2, 3, 3^A, and 4 are cross-sectional line drawings in a plane through the axis of the cylinder and perpendicular to the axis of the crank shaft. In these drawings ABSD represents a section through the cylinder. FG is equal to the radius of the crank. The arrow A′ indicates the direction of rotation of the crank. IH represents the amount of eccentricity of an eccentric which rotates in the same direction as the crank shaft with a speed ratio of 1:2 to the crank shaft. In the following discussion this eccentric is considered as being on the cam shaft. HJ is a raceway arm or slider arm in which the slider KL moves as HJ reciprocates about H as a center. The position of the point J controls the position of the piston through the primary connecting rod MN. The adjusting arm OR is stationary at O but allowed to reciprocate about O as an axis. OR determines the position of the

slider KL in the raceway arm HJ. TF is a secondary connecting rod from the slider to the crank.

Figure #1 shows the position of the working parts at the end of the exhaust and beginning of the intake strokes. The point E′ is the highest position of the piston during the exhaust stroke. As the crank moves in the direction of the arrow A′ the connecting rod TF pulls the adjusting arm OR around O as an axis. As the point R moves around O it forces the slider KL along the slider arm HJ and pulls HJ around H as an axis. J pulls down the piston, admitting the explosive gas into the cylinder.

Figure #2 shows the position of the working parts at the end of the intake and beginning of the compression strokes. The point I′ is the lowest position of the piston during the intake stroke. During the time that the crank has passed over the arc necessary for the intake stroke, the point of greatest eccentricity H, on the eccentric IH, has moved over half this arc; since H is on the cam shaft and geared to the crank shaft with a speed ratio of 1:2. As the point F follows around the crank circle it forces up the secondary connecting rod TF and moves R around O as an axis. As R moves around O the slider KL moves along the slider arm HJ, at the same time HJ is being forced up by TF. KL raises HJ and compresses the gas in the cylinder.

Figure #3 shows the position of the working parts at the end of the compression and beginning of the power strokes. The point C shows the highest position of the piston during the compression stroke. During the time the crank has passed over the arc necessary for the compression of the gas the eccentric HI has moved through half the arc and is now at the point H in Figure #3. As the piston is forced down by the explosion, the raceway arm HJ is forced around H as an axis. As HJ swings around H, the slider KL is forced down against TF and results in a turning force on the crank. As TF moves down, the slider KL is forced out along the slider arm HJ by the adjusting arm OR which moves around O as an axis.

Figure #4 shows the position of the working parts at the end of the power and beginning of the exhaust strokes. The point P shows the lowest position of the piston during the power stroke. As the exhaust port opens the point F forces TF on KL and lifts the raceway arm HJ. HJ raises the piston to the point E and completely exhausts the cylinder of those products of combustion formed during the power stroke.

Although in this specification IH is considered as the amount of eccentricity of an eccentric on the cam shaft, this eccentric may be on a separate eccentric unit; but, since both the cam shaft operating the valves and this eccentric unit would have the same speed ratio to the crank shaft, the same shaft is used for this double purpose. This will eliminate parts and help to give compactness of construction.

Part A.

In this part of the specification the action of the eccentric IH is disregarded, and the point R is considered as being at T or the adjusting arm OR is considered connected to the secondary connecting rod at T. The pressure curve for a common four stroke cycle engine, shown in Figure #5, shows the pressure to be at a maximum at the beginning of the power stroke and to gradually decrease to the end of this stroke. Because of the great pressure the piston may be allowed to move at a high rate of speed at the beginning of the power stroke without relatively decreasing the speed of the engine. In Figure #3, at the beginning of the power stroke, if the ratio of H—N to H—KL is as 2 is to 1, the pressure at T will be approximately twice the pressure at N, and the force exerted at F will be approximately twice the force exerted on the crank of a common type of engine at this position of operation. The piston, during the first part of the power stroke, will travel twice as fast as it does in the ordinary engine and the pressure will be utilized nearly as it is formed. This action will give the same effect on the operation of the engine as the use of tellurium or lead compounds to retard the formation of high pressures at the beginning of the power stroke. The greater speed of the piston will give a release to the pressure and lessen the tendency to develop knocks. As the piston is forced down by the explosion the slider will move out in the raceway arm HJ, and decrease the leverage at F as the pressure in the cylinder decreases and the torque component of the force at F increases; tending to equalize the turning force on the crank over a large arc, and to keep the speed of the piston nearly constant during the first hundred degrees of the power stroke. During the power stroke the crank will pass through approximately 215 degrees of arc although in the ordinary engine the power is distributed over only 180 degrees of arc. By this mechanism a greater amount of the energy in the explosive mixture will be transformed into mechanical power by distributing the torque more evenly over a larger arc of the crank circle. This engine will not consume as much fuel as the conventional type of engine with cylinders of equal proportions, because the piston stroke is greater than the crank stroke. During the intake stroke the intake ports may be allowed to close before the piston has reached its lowest position, and, in this manner, limit the volume of gas

consumed during each cycle of operation. This will result in a saving of fuel by allowing a more complete expansion of the exploding gas, since the volume of the cylinder-cavity will be greater at the time of opening the exhaust ports, at the end of the power stroke, than it was at the time of closing the intake ports, during the intake stroke.

Part B.

The part of the invention considered under Part B is for the purpose of completely exhausting the cylinder after the power stroke and still leave sufficient space for a compression cavity during the compression stroke. It consists of an eccentric on the cam shaft which rotates in the same direction as the crank shaft, and with a speed ratio of 1:2 to the crank shaft. This eccentric controls the position of the bearing H, or the bearing about which the raceway arm HJ reciprocates. At the end of the exhaust and beginning of the intake strokes, the position of greatest eccentricity will be at H in Figure #1. It will be close to, and lower than, the surface KL. This will cause the reciprocating end of the raceway arm to be at its highest position during the cycle of operation, and the piston, at that time, will completely exhaust the cylinder before beginning the intake stroke. At the end of the compression and beginning of the power strokes the point of greatest eccentricity on the cam shaft will have moved from H in Figure #1 to H in Figure #3. It will be farther from KL than it was in Figure #1, and above its position at the end of the exhaust stroke. This will cause the point N to be lower than it was at the end of the exhaust stroke. The point N controls the position of the piston through the primary connecting rod MN. The piston will rise to the point C′ as its highest position on compression stroke and leave the space ABC′ for an explosion cavity.

Part C.

The action of the piston with regard to the position of the crank F, caused by the positions of the points R and H, is considered as the third part of the invention. It enters advantageously into the scheme only at the beginning of the power stroke. If the bearing at R was at T as soon as the crank pin F moved off dead center the piston would start to drop; but since the connection is at R, when F moves off dead center it forces the secondary connecting rod TF to pivot about R as an axis. This will move T nearer to the point H, as in Figure #3A, and move the slider KL towards the eccentric IH. The bearing at J will lift slightly, and tend to raise or hold the piston in its highest position on compression stroke, until the lifting action of KL is overcome by the lowering action of F. By the time the piston starts to drop, or at the time of ignition, the crank will be off dead center and there will be a torque component of the force exerted at F.

In this specification I have considered the mechanism necessary for the Martin leverage cycle as three units described under Parts A, B, and C; not only because I could make my explanation clearer in this manner, but also to show that the first unit, described in Part A, can be incorporated into an engine, and give it the advantages of the first unit without the use of the units described under Parts B and C. The first and second units may be used in an engine and gain the advantages described under Parts A and B, or all three units may be assembled in the same engine and acquire the summation of the advantages of each.

Figures #6, 7, 8, 9, and 10 are mechanical drawings of the parts as they may be constructed in the practical application of my invention. The primary connecting rod, MN in Figures #9 and 10, may be a straight connecting rod with a wrist pin clamp at each end. The raceway arm or slider arm, shown in Figure #8, and shown as HJ in Figures #9 and 10, may be made with a wrist pin bearing at its reciprocating end J, and a larger babbitted bearing at H, its connection with the eccentric. The raceway of this part may be constructed as shown in Figure #8 to give a maximum sliding surface. The slider, KL in Figures #9 and 10, must be made to fit the raceway of the raceway arm. The secondary connecting rod, TF in Figures #9 and 10, may be constructed as shown in Figure #7, with a babbitted bearing at its connection with the crank F; and a wrist pin bearing at T, its connection with the slider. At the connection of the secondary connecting rod with the adjusting arm, R in Figures #9 and 10, may be protruding stud bearings, but in a construction which magnified the effect produced by the position of this bearing, a wrist pin bearing may be used. The adjusting arm, OR in Figures #9 and 10 and shown in Figure #6, may be bent so as to clear the eccentric bearing of the raceway arm at the end of the exhaust stroke. Figure #9 shows the position of the working parts of a practical construction at the end of the intake stroke. Figure #10 shows the position of the working parts of the same construction at the end of the exhaust stroke. These two positions are shown because they illustrate the highest and lowest positions of the piston during the cycle of operation.

What I claim as my invention is—

1. A device of the type described comprising a cylinder, a piston disposed in said cylinder, a crank shaft, and means for connecting said piston to said crank shaft, said means including a primary connecting rod

secured at one end to said piston, a secondary connecting rod secured at one end to said crank shaft, and means operatively connected to the other ends of said connecting rods for holding said primary connecting rod stationary while said piston is in the outermost position and permitting said secondary connecting rod to move during the movement of said crank shaft through dead center.

2. A device of the type described comprising a cylinder, a piston disposed in said cylinder, a crank shaft, a primary connecting rod connected at one end to said piston, a secondary connecting rod connected at one end to said crank shaft, and means connecting the other ends of said connecting rods whereby said piston and said primary connecting rod are held against movement when said piston is in the outermost position and permitting movement of said secondary connecting rod, said means including a slider arm and a slider adapted to move with respect to said slider arm.

3. A device of the type described comprising a cylinder, a piston disposed in said cylinder, a crank shaft, a primary connecting rod secured at one end to said cylinder, a slider arm pivotally secured at one end to the other end of said primary connecting rod and having grooves disposed longitudinally therein, an eccentric, the other end of said slider arm operatively connected to said eccentric, a slider, tongues integral with said slider and receivable within the grooves in said slider arm, and a secondary connecting rod pivotally mounted at one end upon said slider and at the other end upon said crank shaft, said slider arm being adapted to hold said primary connecting rod and said piston in the outermost position and permitting said slider to move with respect to said slider arm during the movement of said crank shaft past dead center.

4. A device of the type described comprising a cylinder, a piston disposed in said cylinder, a crank shaft, a primary connecting rod secured at one end to said cylinder, a slider arm pivotally secured at one end to the other end of said primary connecting rod and having grooves disposed longitudinally therein, an eccentric, the other end of said slider arm operatively connected to said eccentric, a slider, tongues integral with said slider and receivable within the grooves in said slider arm, a secondary connecting rod pivotally mounted at one end upon said slider and at the other end upon said crank shaft, said slider arm being adapted to hold said primary connecting rod and said piston in the outermost position and permitting said slider to move with respect to said slider arm during the movement of said crank shaft past dead center, and means operatively connected to said secondary connecting rod for guiding said secondary connecting rod and said slider in their movement.

In testimony whereof I affix my signature.

CARL C. MARTIN.